UCRL-JC-120934 Abs

In Situ Microbial Filters: A Bioaugmentation Approach for Remediation of Contaminated Ground Water

by
M. C. Jovanovich, A. G. Duba, K. J. Jackson, R. B. Knapp, R. T. Taylor,
C.O. Boro, M. Evans, M. L. Hanna, W.E. Ralph, N. N. Shah,
K. L. Carroll, M. J. Dibley, and R. E. Martinelli

Lawrence Livermore National Laboratory
P.O. Box 808, L-453
Livermore, California 94551
(510) 422-2144

Recent field tests at the Wilson Corners site at the Kennedy Space Center and at the Chico Municipal Airport in Chico, California (CMAS), have demonstrated that an *in situ* biofilter using resting-state cells, can effectively remediate groundwater contaminated with chlorinated solvents.

A three column, down-hole treatability tool, tested in contaminated groundwater at the Wilson Corners site, demonstrated that several chlorinated ethenes could be biodegraded by a pure strain methanotrophic bacteria, *Methylosinus trichosporium* OB3b. Unfortunately, only about 40% of these compounds could be degraded because of the presence of methane and several chlorofluorocarbons, which were also degraded by the microbe, thereby exhausting the available dissolved oxygen. Sparging air into the well increased biodegradation to 60%. The experiment was terminated at this site due to insufficient oxygen in the groundwater.

A second location (CMAS) was selected that had characteristics that favored proving the resting-state biofilter concept in the field. The groundwater was contaminated with 425 $\pm$ 50 μg/L of trichloroethene (TCE) and the dissolved oxygen was 7.0 mg/L. About 5.4 kg (dry weight) of *M.trichosporium* OB3b was suspended in groundwater (2.7 Gcells/mL) and injected into the aquifer through a single well at a depth of 28 m and at a rate of 3.8 L/min. The injected groundwater was devoid of growth substrates and cosubstrates but did contain 10 mM Higgin's phosphate buffer solution and a phenol red tracer. Approximately 50% of the injected bacteria attached to the soil, forming an *in situ*, fixed-bed, quasi-spherical bioreactor with an average radius of about 1.2 m and an attached population density of approximately 500 Mcells/g aquifer material. Contaminated groundwater was subsequently withdrawn through the biofilter by extracting groundwater through the injection well at 3.8 L/min for 30 hr and then at 2 L/min for the remaining 39 days of the field experiment. Results show that 98 percent of the TCE was biodegraded for the first 50 hours of groundwater withdrawal. In the ensuing days, TCE concentrations at the withdrawal well gradually increased as biofilter degradation capacity and/or longevity were exceeded in various parts of the biofilter.

Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

Int. Symp. Env. Anal. Chem. 4-95